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LC_{50} for Insecticides against Second Instar Larvae of Cotton bollworm *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) in Maharashtra

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Abstract

The present study deals with the efficacy of Spinter, Cypermethrin and Karate was assessed by larval dip bioassay against second instar larvae of cotton bollworm *Helicoverpa armigera* collected from the cotton fields at Aurangabad and reared in laboratory until F_1 generation second instar larvae are used to assess the toxicity of insecticide after 48 hours of insecticide treatments. The study result shows that toxicity of Karate was highest with LC_{50} of 70.31ppm followed by Cypermethrin with LC_{50} 277.67ppm and Spinter 454.85ppm. The result showed the resistance increased in *Helicoverpa armigera* against Spinter in F_1 generation in laboratory conditions.

Key Words: Bioassay, *Helicoverpa armigera*, Second instar, Insecticides

Introduction

In Maharashtra, average cotton yield is 650 Kg/hectare, which is still lower production as compare to the other countries like Australia, Egypt, Turkey and USA. In India it suffers heavy yield losses due to insect pest, diseases and weeds. Insect pests alone can cause 20 to 30% loss in potential yield.

Cotton is attack by number of sucking and chewing pests in allover the world. Among the insects the cotton bollworm *Helicoverpa armigera* causes considerable losses (Lohar, 1994). *Helicoverpa armigera* is the polyphagous agriculture pest. The species of *Helicoverpa armigera* comes from broad spectrum of families and include important agriculture crops such as cotton, maize, pigeon pea, sorghum, sunflower, soyabean and ground nuts (Fitt, 1989). Like most other cotton producing countries, pest control largely relied on chemical insecticides. The indiscriminate use of insecticides, particularly during 1980s and 1990s contributed to the emergence of cotton bollworm *Helicoverpa armigera*, as a primary pest of cotton in recent years. It becomes major cause of cotton reduction in India. Control of this pest has not always been adequate probably, due to the development of resistance. Moderate to high level of resistance to pyrethroid and organophosphorus insecticides were recorded in field population of *Helicoverpa armigera* (Kranthi et *al*., 1997). The aim of this study was LC_{50} of test insecticides and insecticide efficacy comparison against cotton bollworm *Helicoverpa armigera*.

Material and Methods

Test insects cotton bollworm were reared in the laboratory on modified semi synthetic diet (Ahmed and Mc Caffery, 1991), under laboratory conditions of 27±2^{0}C, 65±5% RH and 14:10 hrs light:dark. This food was daily changed. A homogenous stock of second instar larvae of *Helicoverpa armigera* was obtained for different insecticidal treatments.

Larval dip bioassay

Aqueous dilutions of formulated insecticides were prepared and batches of larvae were submerged for 5 seconds. Each group of 20 larvae was dropped in 100ml of each appropriate insecticide dilution in 500ml beaker and gently swirled for 5 seconds to ensure complete wetting. The solution plus larvae were then poured through fine muslin suspended over an empty beaker, the solution was decanted and larvae separated by the same process. After shade drying for 10 minutes the treated larvae were then transferred individually into semi synthetic diet. Control insects were treated only with water. This experiment was carried out at 27±1^{0}C under approximately 12h:12h LD photo period. Mortality of larvae was recorded after 48 h of interval. Serial dilutions of the formulated test insecticides (Table 1) were prepared as ppm of active ingredient.

Larval mortality was assessed after 48 hrs of dipping. Results were expressed as percentage mortalities. Statistical analysis was done by log probit using the computer program PC-POLO software (Robertson et. *al*., 1980).

Table 1 Different insecticides used for LC_{50} for Insecticides against Second Instar Larvae of Cotton bollworm Helicoverpa armigera

Insecticide	Formulation	Active Ingredient	Range	No. of Conc.
Spinter	40EC	Chlorpyriphos	50-500	7
Cypermethrin	5EC	Cypermethrin	50-300	5
Karate	2.5EC	Cyclothrin	50-200	4

Table 2 Toxicity of insecticides on Cotton Bollworm *Helicoverpa armigera* after interval of 48hrs

Insecticide	Dose ppm	N	M	MM	Slope ± SE	LC_{50}	95% FL of LC_{50} Lower / Upper		X^2
Spinter	50	20	0	0	8.48 ± 2.38	454.85	427.03	535.10	1.7
	100	20	0	0					
	150	20	0	0					
	200	20	0	0					
	300	20	1	5					
	400	20	6	30					
	500	20	14	70					
Cypermethrin	50	20	2	10	1.78 ± 0.56	277.67	231.86	409.59	0.28
	100	20	4	20					
	150	20	6	30					
	200	20	7	35					
	300	20	11	55					
Karate	50	20	8	40	1.37 ± 0.03	70.31	25.44	101.32	0.22
	100	20	12	60					
	150	20	14	70					
	200	20	14	70					

Result and Discussion

The result of toxicity of test insecticides to second instars larvae of cotton bollworm *Helicoverpa armigera* are presented in (Table 2). The data revealed considerable variations in the responses of cotton bollworm *Helicoverpa armigera* larvae to the insecticide applied. Among the insecticides Spinter 40EC proved to be least toxic to *Helicoverpa armigera* with highest LC_{50} (454.85 ppm) as compared to Cypermethrin and Karate.

LC_{50} of Cypermethrin was 277.67 ppm showing 1.61 times high effectiveness of cypermethrin over Spinter. LC_{50} value of Karate 70.31 ppm was found highly toxic to second instar larvae of *Helicoverpa armigera* as compare to Spinter and Cypermethrin. It was observed that LC_{50} value of 6.51 times less than LC_{50} value of Spinter and 2.80 times less that of Cypermethrin. From the study it is cleared that Karate was much more effective than Cypermethrin and Spinter.

Fakrudin et *al.,* (2003) reported that maximum resistance to Chlorpyriphos was recorded in Guntur followed by Nalgonda District of Andhra Pradesh State. Least resistance ratio against susceptible strain was found to be highest for the population of Guntur followed by Nalgonda and Raichur districts. The ratio was recorded in population from Kovilpatti and Madurai. Cypermethrin in this study was comparatively effective as compared to Spinter. Similar results were obtained about the low resistance to Cypermethrin among various strains of *Helicoverpa armigera* collected from different localities of Pakistan and also from Marathwada region of India (Ahmad et *al.,* 1997, Nimbalkar et. *al.,* 2008). Resistance to quinalphos increased by 30 to 60% and show high level of resistance to cypermethrin (Nimbalkar et *al*., 2009). The results were in agreement with the result of Ahmad et *al.*, (1997) that karate was most effective and pests showed low resistance.

The population of *Helicoverpa armigera* collected from cotton growing areas of south sulawesi, Indonesia in 1987 and 1988 were resistant to cypermethrin (Mc Caffery et *al*., 1989). High level of resistance was reported to synthetic pyrethroids (Kapoor et *al*., 2002). According to Mc Caffery et *al.*, (1989), population of *Helicoverpa armigera* collected in October 1987 from coastal cotton growing districts in Andhra Pradesh was highly resistant to cypermethrin. Resistance of *Helicoverpa armigera* to insecticide especially pyrethroids was disastrous to Israeli growers (Horowitz et *al*.., 1993).Higher level of resistance was observed against synthetic pyrethroids in those regions where pyrethroids use was most frequent i.e. 4-8 applications per season (Kranti et *al*., 2001).

Information based on these results would help in avoiding economic loses because of insecticide dosage concentration and also helps in better integration of insecticides into IPM and IRM program for the control of largest pests in India.

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